Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Supporting Information

Solution assembly MoS_2 nanopetals /GaAs n-n homotype heterojunction with ultrafast and low noise photoresponse using graphene as carrier collector

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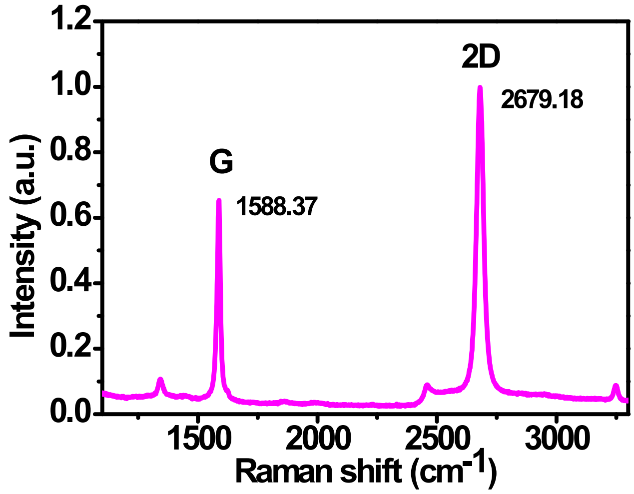

Fig. S1 Raman spectrum of graphene used as carrier collector in our device.

Synthesis of few-layer graphene films (FLG)): The few-layer graphene(FLG) films were synthesized at 1000℃ via a chemical vapor deposition (CVD) method by using a mixed gas of CH_4 (40 sccm) and H_2 (20 sccm) as a reaction source, with 30 mm thick Cu foils as the catalytic substrates. After deposition, the graphene films were spin-coated with polymethylmethacrylate solution (PMMA in chlorobenzene, 5 wt%) and the underlying Cu substrates were removed in Marble's reagent solution ($CuSO_4$:HCl:H_2O = 10 g:50 mL:50 mL). The graphene films were rinsed and stored in deionized (DI) water for device fabrication in further.

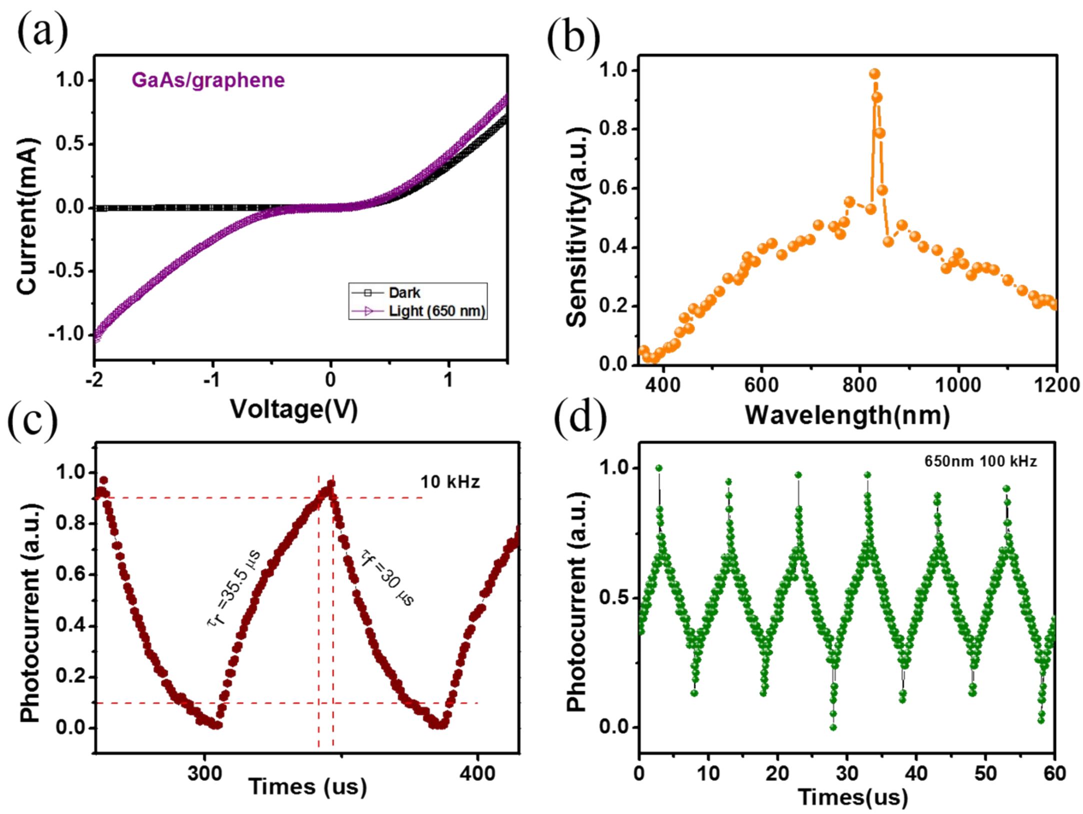

Fig. S2. The photo-electric characteristic measurement of GaAs/graphene device used for comparison with our PDs. The measurement is taken under the same condition with Figure 3 and Figure 4. (a) The *I-V* curve of GaAs/graphene device under dark and light illumination (650 nm, ≈20 $mWcm^{-2}$), respectively. (b) Spectral response of GaAs/graphene device.(c) and (d) show time response characteristics of the device to the pulsed light at the frequency of 10 kHz and 100 kHz,respectively (650 nm, ≈20 mW cm^{-2}).

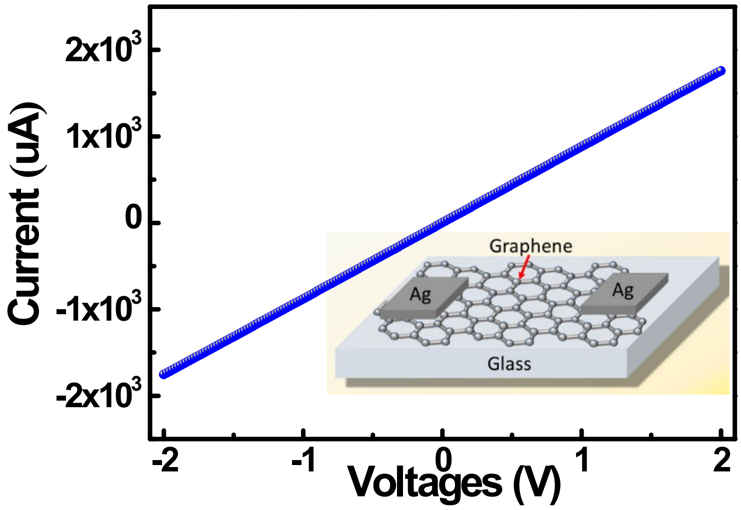

Fig. S3 The *I-V* curve of Ag /Graphene device used to make sure the contact. The measurement is taken at room temperature and the linear behavior suggests reliable ohmic contacts. Inset shows the schematic of the device.

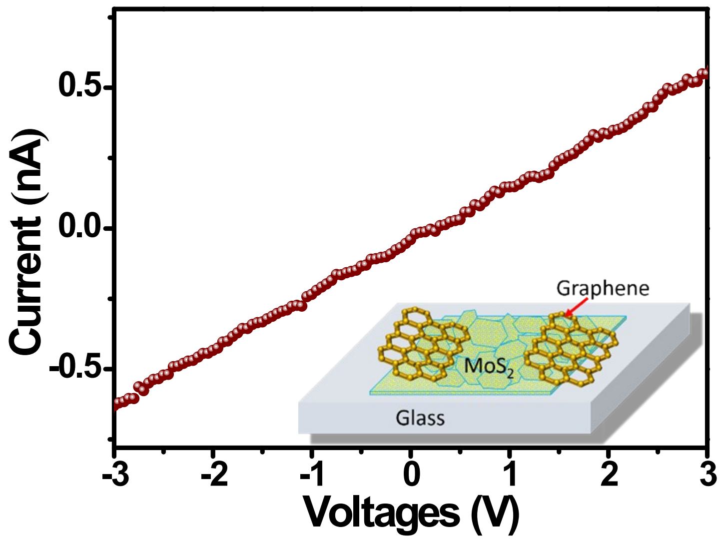

Fig. S4 *I-V* characteristics between two graphene contacts on the MoS_2 nanopetals film taken at room temperature.

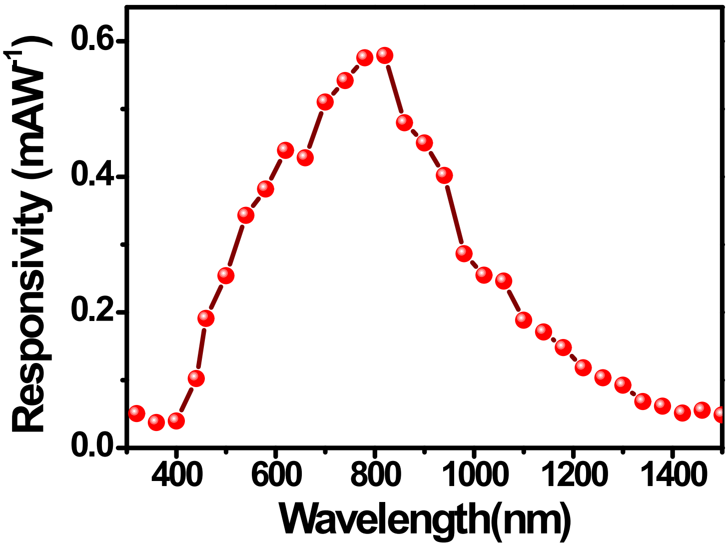

Fig. S5. The wavelength-dependent responsivity (R)

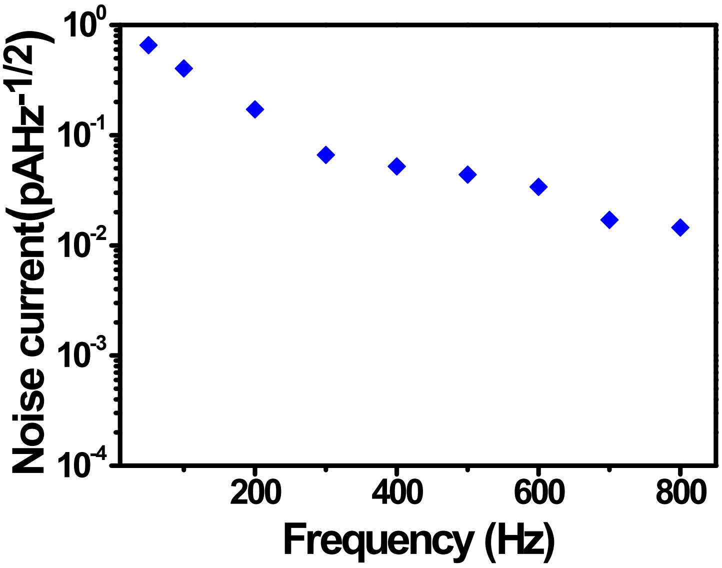

Fig. S6 Measured dark current noise of the photodetectors at different frequencies at zero bias.

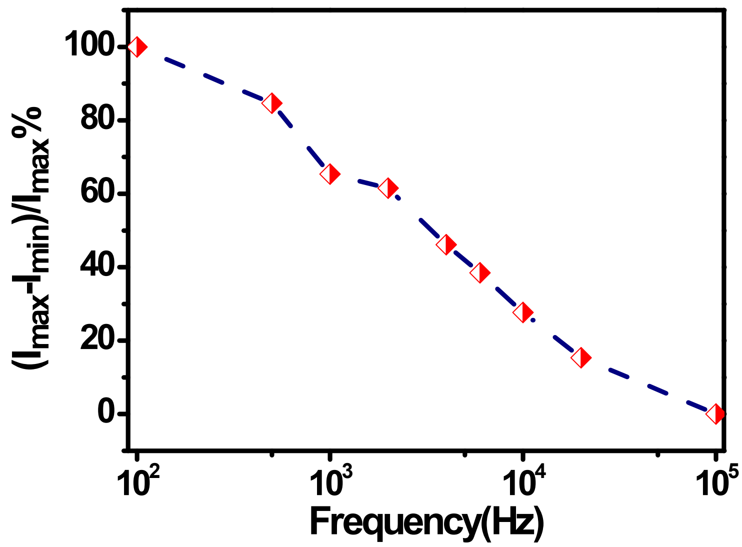

Fig. S7 Frequency dependence of relative balance value $((I_{max} - I_{min})/I_{max})$.